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Fig. 1. — Forty-nine members of the last senior class.

Fig. 2. — The same as fig. 1, but adjusted for the eyes.

Fig. 3. — Ten members of the same class, forming division in physics.

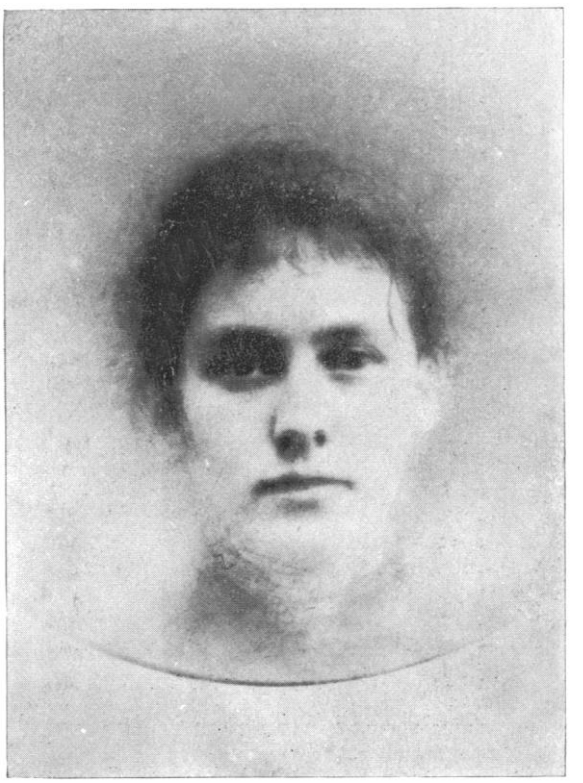

Fig. 4. — Twenty members of the last senior class.

COMPOSITE PORTRAITS OF SOME SMITH COLLEGE STUDENTS.

SCIENCE, *July* 30, 1886

SCIENCE.

FRIDAY, JULY 30, 1886.

COMMENT AND CRITICISM.

THE ANNUAL REPORT for 1885, of Prof. J. P. Lesley, state geologist of Pennsylvania, contains a review of the conditions of the survey since its re-establishment in 1874 that does not show a highly enlightened policy on the part of the Pennsylvania legislature. The total appropriations for the thirteen years from 1874 to 1886 were $545,000, averaging $42,000 a year; but for 1885 a total expenditure of under $24,000 was allowed, and at the beginning of this year there was a balance of less than $36,000 on hand for the expenses of all of 1886 and the first part of 1887. So small a sum is entirely insufficient to insure proper official care of the enormous mineral interests of the state. The reduction of the appropriation for last year and this is the more embarrassing on account of the requirement that the work done shall include a greater variety of investigation than had been planned by the survey. The more important subjects reported upon for 1885 are the oil and rock gas about Pittsburgh, by Carll; the structure of the Pittsburgh coal-region, by d'Invilliers; the origin of coal-beds, by Lesquereux; and the anthracite survey and the kaolin deposits of Delaware county, by Ashburner. The anthracite survey, of the greatest technical and practical value, has been seriously hampered for want of funds. The same report gives an account of the method of distribution of the survey publications followed until lately, which, to put it mildly, does not reflect credit on the legislators at Harrisburg. The original regulation in 1874 ordered, that, after supplying a very moderate number of persons and institutions at the cost of the state, all others should obtain the desired volumes only by purchase at cost. But there was little or no sale, because citizens of the state were well accustomed to obtaining state documents free of cost from their representatives: consequently, when the first volumes appeared in 1875, and a demand for them was made on the members of the legislature, an act was at once passed providing for *a special edition* of 5,000 copies of every report, for the use of the senate and house. In this way, 425,931 copies have been distributed by the legislators; and it is safe to say that a good part of this distribution has been made indiscriminately, while the survey has had practically no copies to dispose of; and of the editions published for sale, counting up to 110,569 copies, there remained unsold 43,118 copies in 1885. In view of this, an act was passed last year disposing of reports as follows: 500 copies to the senate, 2,000 to the house, 150 to the state geologist, 600 to the board of commissioners, for local institutions and general exchanges, 250 to certain state officials. This will greatly reduce the careless distribution by the legislature, and will allow the board of commissioners an authority that should have been theirs from the first. The attempt to establish a topographical survey of the state has been unfortunately a failure. The coast survey is proceeding with the triangulation of the state, and has covered about one-third of its area; but the legislature would not accept the offer of the U. S. geological survey to assist in carrying on the topographic work, even though the survey agreed to expend $30,000 a year while the state should expend only $10,000. The proper mapping of the state will cost, it is estimated, half a million dollars, and, if supported only by state appropriations of ten thousand dollars a year, would require half a century for its completion. That is too long for an intelligent state to wait.

COMPOSITE PORTRAITURE.

THE composite portraits which are published to-day were made from groups of undergraduates of Smith college. Figs. 1 and 2 each contains forty-nine members of the last senior class; fig. 4 is a composite of a selected group of the same class, containing twenty individuals; while fig. 3 was made from ten members of the class of '85, who formed an elective division in physics. The average age of all the groups is about twenty-two years.

These portraits may serve as text and illustration for a few remarks on some points of interest in this method of obtaining 'pictorial averages.'

The great difference between figs. 1 and 2 strikes one at once, and yet they were both made from exactly the same negatives and under the same conditions, except that in fig. 2 the nega-

tives were so adjusted that the pupils of the eyes in each case fell upon the same points of the sensitive plate, while in fig. 1 the distance from the line of the eyes to the mouth was made constant.

The result of these different modes of adjustment is apparent in the multiple mouth which disfigures fig. 2, and in the less clear definition of the eyes in fig. 1, in which the component eyes fell upon slightly differing points in the same horizontal line.

The question at once arises, which of these faces, if either, in its general outline and expression, is the true average of the group? In seeking the typical features should we choose fig. 1, and correct the dimness of the eyes, or take fig. 2, and substitute a single mouth in the middle of the blur? As far as I can learn, this question of adjustment and its results has not before been raised. It is, however, a question of importance to all who are interested in composite photography; for only those composites which are made according to the same method of adjustment can be properly compared as types.

In any group of persons not chosen with special reference to facial symmetry, the ratio of the distance between the pupils of the eyes to that between the line of the eyes and the mouth is a variable one; and adjustment to either distance as a constant for the group will give its corresponding and differing composite. Mr. Galton makes the distance from eyes to mouth constant ('Inquiries into human faculty,' p. 359). The portraits of American men of science (*Science*, v. No. 118) seem (from the tendency to multiple mouths and noses, especially noticeable in fig. 1) to have been made, as fig. 2 was, by matching the eyes, though in these cases the beard prevents the prominence of the disfigurement which this adjustment gives in the case of smooth faces.

If a fixed distance between eyes and mouth be taken for adjustment, the composite will have a single distinct mouth, but will differ in form according to the distance chosen; if it be that of the shortest or of the longest face in the group, the composite face will be correspondingly short or long, and the indistinctness of the eyes at a maximum. But if, on the other hand, a component face of average length (i.e., one in which the ratio of the distance between the pupils of the eyes to that between the line of the eyes and the mouth is a mean one) be chosen, the resultant portrait will show a minimum indistinctness of eyes, and give what we may fairly call the pictorial average of the group. The average ratio which must serve for fixing the fiducial lines can be obtained from direct measurements on the negatives. This will not be a formidable task, if, as is usual, the negatives are taken so that the distance between the pupils is the same in all; since in this case it is only necessary to measure the distance from eyes to mouth in each, and take the mean.

This point is one which should be carefully attended to in making composites. for it would seem to be the only normal method of adjustment; all other adjustments giving more or less pronounced variants from the type.

Composites made in this way lose something of the deep-eyed, earnest expression, which is the result of superposing all the eyes of the components on exactly the same points. This loss, however, is a real gain in the truthfulness of the composite portrait, for the deep dark eyes do not represent the average, but rather a summation, and hence exaggeration of earnest expression. The face in fig. 1 is, I believe, a fairly normal composite of the group of forty-nine from which it was made; fig. 4 is from a group selected for facial symmetry, i.e., constancy of the ratio indicated, and is a type of this group with the exaggeration which comes from superposition of the eyes. Questions as to the possible dependence of the result on the order in which the components are taken, and on the time given to each exposure, occur to every one who interests himself in composite photography. In Mr. Galton's earliest paper on the subject, he speaks of six composites made from the same three components taken in their six possible combinations, and says, "It will be observed that four at least of the six composites are closely alike, . . . the last of the three components was always allowed a longer exposure than the second, and the second than the first, but it is found better to allow an equal time to all of them. In a later experiment, composites were made of four differently colored disks, whose images were superposed in four different orders, while the times of the successive exposures were equal. The result was four composite disks 'of precisely uniform tint.' The inference from this is, of course, that the order of exposure makes no difference when the times of exposure are equal (equal illumination of the image is assumed). The experiments which I have made on this point by taking composite portraits from the same components in different orders (with equal times of exposure) have shown that the order of exposure does affect the result. I have also repeated Galton's other experiment in several modified forms, both with disks of colored paper and with colored glasses (by transmitted light), and obtained results which, especially in the case of the

colored glasses (by far the fairest test), confirm those of Galton.

Experiments of this kind are far more satisfactory than those in which composite portraits are made from the same components taken in different orders: for one has to decide in the one case merely on the identity or difference of tint of disks or rectangles placed side by side on the same plate; in the other, of faces with their manifold detail.

Answers to both of these questions as to order and time of exposure would be found in knowledge of the rate at which light acts upon the silver salts of the photographic plate.

If the rate of this action is constant up to the point of a 'full-timed' plate, then the order in which the negatives are taken can make no difference, provided each successive fractional exposure is of equal length, and the image is in each case equally illuminated. If the velocity with which the chemical action proceeds is not constant, then the order will obviously make a difference in the result, unless the exposures are prolonged or shortened, or the illumination made stronger or weaker, as the velocity decreases or increases.

As far as I am aware, we have no knowledge of the rate of chemical action in this instance, except that which is given by the experiments above referred to, and which points to a constant rate of action within the limits of ordinary photographic exposures. Thus Galton's process appears as a valuable auxiliary in the investigation of an interesting point of the obscure field of photographic chemistry.

The possibility of the 'prepotency' of some individual of the group as a disturbing element was suggested in *Science*, v. No. 118, and has since been discussed by Mr. Jastrow in vol. vi. No. 134. Since the composite portrait is the result of the action of light on the silver salts, it would seem plain that no one face, however 'individual,' 'powerful,' or 'characteristic' it may be, can be prepotent in controlling the result. We must conclude that the apparently prepotent face is merely a close approximation to the type or average of the group.

In the hope that more may be induced to do something in composite photography, I would say that excellent results can be obtained with an apparatus which is by no means elaborate or costly. A camera for the purpose can be made of soft wood by any skilful carpenter. It need differ from the usual form only in having a mirror which is hung within so that it can swing down to an angle of 45° for the adjustment, and up against the top for exposures; and an opening in the top, over which a ground-glass plate is fixed. On this ground glass the fiducial lines are drawn in lead-pencil, and the images focused and adjusted. It must be at the same optical distance from the lens (the light being reflected to it by the mirror) as the ground glass at the back of the camera. A piece of ground glass placed behind the negatives will serve very well in place of a condensing lens for lighting them, and it is not necessary to enclose the gas jet in a lantern.

In order to give accurately timed exposures, I use a pendulum consisting of a wooden rod with sliding weights above and below the point of suspension, and having an arm at right angles to it. At the extremity of this arm is a screen of card or ferrotype plate, which, when the pendulum is swinging, plays up and down in front of the camera tube. Matters are so arranged, that, when the pendulum is at rest, the lower edge of the little screen lies across the horizontal diameter of the tube. After the negative is adjusted, the screen is held down so as to cover the end of the tube, while the slide in front of the sensitive plate is drawn, and then released and allowed to make a double vibration. The time of exposure is that of a single vibration of the pendulum, and this is regulated by adjustment of the sliding weights.

I find, as others have doubtless found, that the best composites are obtained from very 'dense' negatives. Those from which the composites in this number were taken were made for me by Mr. Lovell of Northampton, who succeeded admirably in obtaining strong negatives of very uniform density.

JOHN T. STODDARD.

NATIONAL EDUCATION ASSOCIATION.

IN point of numbers, the National education association meeting at Topeka, Kan., was among the most important ever held. As far as permanent educational literature is concerned, however, the contributions hardly correspond to the size of the gathering. The real value of such meetings must always be found in the quiet friction of mind with mind, and in the informal talks where men learn the experience of their fellow-teachers and become acquainted with the educational sentiment of distant sections. There is no better place than these to feel the educational pulse, and learn the temper of teachers on mooted points.

Both in the association and the council that preceded, the subject of industrial education was discussed at great length and with the widest divergence of opinion. Dr. S. H. Peabody of Illinois presented the report, which was an admirable paper, clearly and without prejudice outlining the theory of industrial education. To an outsider this whole question seems unnecessarily forced to the front. Only three per cent of our